

WHAT IS CLAIMED IS:

1. A facing-targets-type sputtering apparatus for producing a film on a substrate comprising:

a vacuum chamber vessel having two openings formed in two corresponding facing side faces thereof;

a pair of target units disposed so as to cover the corresponding two openings, each unit having a target on a vacuum chamber side;

a substrate holder for holding a substrate disposed at a position beside a discharge space between the targets; and

a power supply unit for supplying direct-current power and high-frequency power to the paired targets,

wherein said paired target units each comprises:

a cooling block for holding the corresponding target on a surface thereof;

magnetic field generation means for generating a magnetic field in such a manner as to surround the discharge space ; and

electron reflection means for reflecting an electron to the discharge space disposed on the magnetic field generation means in such a manner as to surround the corresponding target.

2. A facing-targets-type sputtering apparatus for producing a film on a substrate comprising:

a box unit having a discharge space provided therein and having at least three openings formed in corresponding

three side faces thereof including two facing side faces;

a pair of target units disposed so as to cover the corresponding two facing openings, each unit having a target on the discharge space side;

a substrate holder for holding a substrate in such a manner as to cause the substrate to face the opening not covered with said target unit; and

a power supply unit for supplying direct-current power and high-frequency power to the paired targets, wherein said paired target units each comprises:

a cooling block for holding the corresponding target on a surface thereof;

magnetic field generation means for generating a magnetic field in such a manner as to surround the discharge space; and

electron reflection means for reflecting an electron to the discharge space disposed on the magnetic field generation means in such a manner as to surround the corresponding target.

3. A facing-targets-type sputtering apparatus according to claim 2, wherein said box unit has openings in corresponding six side faces thereof; the side face which opposes the opening facing said substrate holder is covered with a target unit having a target and a cooling block without the magnetic field generation means and the electron reflection means; and the remaining two openings are covered

with corresponding closing units.

4. A facing-targets-type sputtering method for producing a film on a substrate which comprises:

(a) generating a magnetic field extending between two targets from one target to the other, the targets being disposed a predetermined distance away from each other, in such a manner as to surround a discharge space provided between the paired targets, to thereby confine plasma within the discharge space by means of the magnetic field; and

(b) performing sputtering under vacuum to form a film on a substrate disposed at a position beside the discharge space, wherein

electrons are caused to be reflected into the discharge space by use of electron reflection means disposed around the corresponding targets, and

power generated through superposition of high frequency power to direct current power is applied to the targets to effect the sputtering.

5. A facing-targets-type sputtering method according to claim 4, wherein in addition to the magnetic field extending between the targets from one target to the other, a circular arc magnetic field is generated at a peripheral edge portion of each target.

6. A facing-targets-type sputtering method according to

claim 4, wherein the side faces of the discharge space is closed except for a side face which faces the substrate.

7. A facing-targets-type sputtering method according to claim 6, wherein a side face opposite to the side face facing the substrate is closed by a target unit.

8. A facing-targets-type sputtering method according to claim 4, wherein the electron reflection means and the targets are made of the same material.

9. A facing-targets-type sputtering method according to Claim 4, wherein the targets are of Cu, a Cu alloy, Al, or an Al alloy.

10. A facing-targets-type sputtering method according to claim 4, wherein a film is formed at a gas pressure of 0.5 Pa or lower.

11. A facing-targets-type sputtering method according to claim 9, wherein the film is a conducting film.

12. A facing-targets-type sputtering method according to claim 11, wherein the film is formed at a gas pressure of 0.05 Pa or lower.

13. A facing-targets-type sputtering method according

to claim 11, wherein the film is a metal film.

14. A facing-targets-type sputtering method according to claim 4, wherein a sputtering unit comprising the facing targets is a box-type sputtering unit configured to close side faces of the discharge space except for a side face facing the substrate; and the film is formed at a gas pressure of 0.01 Pa or lower.

15. A facing-targets-type sputtering method according to claim 14, wherein a side face opposite to the side face facing the substrate is closed by a target unit.

16. A facing-targets-type sputtering method according to claim 14, wherein the film is a metal film.

17. A facing-targets-type sputtering method according to claim 16, wherein the film is a wiring film of a semiconductor device.

18. A facing-targets-type sputtering method according to Claim 15, wherein the metal film are of Cu, a Cu alloy, Al, or an Al alloy.